

# Women's strategies for handling household detergents

Rima R. Habib\*, Amal El-Masri, Robin L. Heath

*Faculty of Health Sciences, American University of Beirut, Beirut, Lebanon*

Received 18 October 2005; received in revised form 2 February 2006; accepted 3 February 2006

Available online 17 April 2006

---

## Abstract

Performing household-cleaning chores involves the use of chemical detergents; these are commonly believed to provide cleaner and safer households. Occupational health studies have associated health risks with detergents, including respiratory and skin problems. Women are the major users of household detergents, as they are in general the primary homemakers. Detergent-handling strategies including storage, use, and precautionary measures affect women's exposure to chemical detergents and thus affect their health. Studies investigating the behavioral component of chemical exposure to detergents at the domestic level are scarce. In this study of detergent-handling strategies, women's potential exposure was investigated by an ergonomics methodology combining in-depth interviews and observations. The participants were 28 women who were responsible for cleaning chores in their households. The women lived in Nabaa, a low socioeconomic, religiously and ethnically diverse neighborhood on the outskirts of Beirut, Lebanon. Information on how women in Nabaa used and perceived household detergent, added to the understanding of their potential chemical exposure. All the study subjects washed dishes, cleaned bathrooms, and swept floors on at least a daily basis. We found that more than half of the participants stored different incompatible detergents in close proximity to each other. Many of the women stated that they over-consumed detergents. A large proportion mixed different detergents together but most of them opened the windows while cleaning for ventilation. The majority did not wear gloves and did not follow label directions. The participants were consistently exposed to chemical detergents and minimal precautionary measures were taken. Cleanliness and hygiene had a strong cultural value and were of utmost importance to women who prioritized them over excessive exposure to chemicals. The use of an ergonomics methodology provided access to important information concerning how women make choices that affect their environmental exposure.

© 2006 Elsevier Inc. All rights reserved.

**Keywords:** Women; Household-cleaning products; Exposure; Chemical detergents; Handling strategies

---

## 1. Introduction

Chemical detergents are commonly used in households for maintaining a clean indoor environment. They have a wide range of applications and contain chemical ingredients such as corrosives, allergens and carcinogens (Messing, 1998a). A large number of these products are currently listed on the Household Products Database of the National Library of Medicine, with reference to their potentially toxic effects (National Library of Medicine, 2003). Prior studies have assessed the health effects of detergent exposure mainly in occupational settings, with the most common effects being dermatitis and respiratory ailments (Arif et al., 2002, 2003; Cherry et al., 2000; Dickel

et al., 2002; Fowler, 1998; Karjalainen et al., 2002; Kogevinas et al., 1999; Mapp et al., 2000; Medina-Ramon et al., 2003; Messing, 1998a; Rosenman et al., 2003; Zock et al., 2002). Little evidence is available on the health effects of long-term, low-level chemical exposure on homemakers (Mergler, 1999).

Exposure to household detergents is affected by the way people handle them in terms of storage, use (amount, frequency, duration, and methods), and precautions. Thus, it is important to describe these strategies, as they define the behavioral components of exposure and allow meaningful exposure assessment (ECETOC, 1994). The few studies that have investigated detergents and human behavior have shown a large variation in the strategies people employ in the use of these products and a general lack of protective measures (Hughson and Aitken, 2004; van Veen et al., 2001; Weegels and van Veen, 2001).

---

\*Corresponding author.

E-mail address: [rima.habib@aub.edu.lb](mailto:rima.habib@aub.edu.lb) (R.R. Habib).

Because chemical products are used differently, exposure becomes complex and cannot be understood by merely identifying the type of chemical substances and the exposure level or the chemical concentration (Mohammed-Brahim, 1999; Weegels and van Veen, 2001). For example, Hakkinen (1993) demonstrated that the different ways of handling a granular detergent product led to different amounts of detergent dust being inhaled by the consumer. If detergents are used in high concentrations, mixed, or used under poor ventilation conditions, a potential health hazard may ensue (Messing, 1998a). Failing to notice the directions for use found on detergent labels has also led to problems (Ivanov et al., 1997).

Domestic labor has been traditionally considered a woman's responsibility (Demo and Acock, 1993). Women, who are in general the primary homemakers, buy and use cleaning products more frequently than men do (Kovacs et al., 1997). Previous research carried out in disadvantaged urban communities in Lebanon has shown that girls begin household-cleaning tasks as early as 5–9 years (Habib et al., 2005) and are therefore exposed to detergents at a young age. The authors, who lived in Western countries for a long stretch of time, noticed while living in Lebanon the enormous amount of cleaning Lebanese women do compared to their Western counterparts. Having a clean house seems to be deeply engrained in Lebanese society. Dishwashing detergents, bleach, all-purpose cleaners, tub and tile cleaners, toilet-bowl cleaners, disinfectants, glass cleaners, laundry detergents, and laundry softeners seemed to be very popular detergents in Lebanon, where “imitation” (without names) household detergents are abundantly found on the market shelves.

Considering the frequent use of household detergents by women and the limited information on the health consequences of exposure to these products in the home, this study aimed to examine women's strategies and perceptions regarding the handling of household detergents, using an ergonomics methodology developed to reveal skills involved in women's work (Teiger and Bernier, 1992). To our knowledge, this is the first study in Lebanon and the region to investigate women's use of household detergents.

## 2. Materials and methods

The methods used in this study were adapted from the model developed by French ergonomists (Guérin et al., 1997; Messing et al., 2005), and adapted to the study of women's work (Teiger and Bernier, 1992). Observations of real work strategies were complemented by interviews in which the women were asked about the reasons for their observed choices of detergents and cleaning operations.

Twenty-eight women in charge of homemaking and household-cleaning chores participated in this study. They were selected from Nabaa, an impoverished densely populated area on the outskirts of East Beirut, Lebanon. Nabaa is inhabited by families from Mount Lebanon, and to a lesser extent by families originally from South Lebanon. This area also harbors workers from neighboring Arab countries and from Southeast Asia and Africa (Makhoul, 2003). In this study, only Lebanese residents were interviewed and observed. Snowball sampling was employed to select

the women (Atkinson and Flint, 2001). Recruiting was done by visiting the women and describing the research and its purpose. If the women agreed to participate, informed consent was read and explained to them to comply with the guidelines of the Institutional Research Board at the American University of Beirut. All participants personally performed their daily household chores; their financial situation did not allow them to employ domestic helpers, as do many Lebanese women of higher socioeconomic class.

The fieldwork in this study consisted of an initial phase of social visits, acquaintance, and recruitment, followed by two phases of data collection: observation and interviews. The ergonomic method, involving direct observation and in-depth interviews, was employed in data collection to add accuracy and complete the information gathered. An observation checklist and an interview schedule were pilot tested prior to data collection. The social visits were carried out in May and June 2004 and the observations and in-depth interviews were carried out between July and September 2004, mainly during the local summer season. All interviews were conducted in the local language (colloquial Arabic). Two observers were trained to conduct the in-depth interviews and observations.

Report between the participants and the researchers was established during the short social visits, during which a suitable time for the observations was scheduled. Each participant was visited at least twice during the data collection phase. In the first data collection phase, participants were observed while performing the usual cleaning tasks in their own homes. Observations focused on types and labels of detergents, storage practices, frequency of use, amounts used, methods of use, and precautionary measures. Factors were identified that affected the use of detergents in cleaning the kitchen, bathroom, floor, and windows and in doing the laundry. The amount of detergent used in each cleaning activity was observed and measured in (1) seconds (using a stopwatch) or number of filled bottle caps, if detergent was in liquid form, (2) cups or handfuls, if in powder form, on (3) splashes, if in liquid spray form. The amounts were later measured in the laboratory and converted into milliliters or grams, depending on the physical state of the substance being measured. The duration of cleaning activities was observed and measured in minutes using a digital stopwatch. The observations on precautionary measures included measuring the extent of bending toward the area being cleaned by approximating the angle of the women's position to that of the cleaned area (45°, 60°, or 90°) and the proximity of her body to detergents; and taking notes on whether women wore gloves and whether women ventilated the area by opening windows/doors when cleaning.

The observations were recorded on a checklist and by taking notes on individual cleaning practices and other factors that affected the handling of detergents. Observations were usually done during the morning hours when participants generally carried out their cleaning chores. The duration of observations ranged between 2 and 4 h.

The second phase of data collection was done using a face-to-face, in-depth interview with every woman in her home. The interview was tape-recorded after obtaining the women's permission; it consisted of several open-ended questions and probes and included a request to describe a typical day of household-cleaning activities. The questions sought information on the following: (1) frequency of performing cleaning chores, (2) average monthly consumption of detergents, (3) strategies employed for mixing detergents if applicable, (4) various habits employed in cleaning and using detergents, (5) storage practices, (6) strategies employed for personal protection, and (7) sharing of cleaning chores with household members, in addition to other factors perceived by the women as affecting their use of detergents. The duration of interviews ranged between 30 and 60 min.

The interviews were transcribed from the audiotapes and translated from colloquial Arabic to English. The authors individually examined the transcripts for the purpose of determining recurrent themes that emerged across the interviews and by consensus reached an agreement as to the best thematic categories. The interviews were coded into these categories. Ten percent of the coded transcripts were cross-checked for accuracy. The respondents' verbatim transcripts were coded and then uploaded into the CDC EZ-TEXT, a software program designed to manage and analyze qualitative data (CDC, 2000). The data obtained from the observation

checklists were entered into SPSS 12.0 (Games International Incorporated, 2004).

### 3. Results

#### 3.1. Participants' profiles

All 28 participants were Lebanese women who originally came to Beirut from various regions of Lebanon. Their age ranged between 22 and 48 years with an average of 33.5 years. Forty-three percent (12 women) had an elementary-level education, 32% (9) had an intermediate-level education and the rest had either secondary-level (5) or university-level (2) education. Sixty-four percent were not in paid employment and 82% had children. Fifty percent had a monthly household income of less than 600 U.S. dollars to meet the needs of three to five household members. Around one-third of the women were economically active: four women worked as beauticians, two women were sales representatives, one was a tailor, one a secretary, one a nurse, and one a bank housekeeper (Table 1).

#### 3.2. Strategies for detergent use

The types and amounts of detergents used, the alternative substances employed, the frequency and duration of cleaning activities, mixing detergents, cleaning methods, and the psychosocial factors involved in cleaning were explored in this research.

##### 3.2.1. Types

The majority of women used a diverse set of products: dishwashing detergent, bleach, liquid and powdered all-purpose cleaner, toilet-bowl cleaner, disinfectant, glass cleaner, laundry detergent, and softener (Table 2). Those who did not use bleach and toilet-bowl cleaner said that they were harmful to health. The women who did not use liquid all-purpose cleaner, disinfectant, and laundry softener said that they were unaffordable.

Imitation detergents were described as products with low quality and efficacy and with no-name brands that made the participants use greater quantities to achieve the required effectiveness. The labels of most of the detergents used were written in Arabic and did not list any instructions for use.

Unconventional uses of household detergents were observed among women. Fifty percent of the women used a product in a cleaning activity different from its original purpose; for instance, a tub and tile cleaner was used to wash windows, a toilet-bowl cleaner to clean the washing machine, a disinfectant to clean windows and walls, and a glass cleaner to clean the oven. Fifty-four percent of the women also made some substitutions; for example, bleach and dishwashing detergent (or powdered all-purpose cleaner) mixture was used as an alternative to liquid all-purpose and tub and tile cleaners.

Table 1  
Participants' characteristics ( $n = 28$ )

	Number	Percentage (%)
Age (years)		
≤30	10	36
31–39	9	32
40+	9	32
Education		
Elementary/Intermediate	21	75
Secondary	5	18
University	2	7
Type of employment		
None	18	64
Beautician	4	14
Sale representative	2	7
Tailor	1	4
Nurse	1	4
Secretary	1	4
Bank housekeeper	1	4
Household monthly income in U.S. dollars		
<300	2	7
300–499	6	21
500–749	9	32
≥750	8	29
Unknown	3	11
Number of children		
≤1	8	29
2+	20	71
Number of household members		
≤4	14	50
≥5	14	50

##### 3.2.2. Frequency and duration

I have been sweeping the floor this way, every day, for ten years (27 year-old woman).

The frequency and duration of detergent use depended on the frequency and duration of each household-cleaning activity (Table 3). Dishwashing was done three or four times a day for an average of 7 min, during which the detergent and bleach were added repeatedly. Women indicated that they washed the dishes following every meal, three times a day; they did more when they had a large family or when they had visitors. Cleaning the stove was a daily activity that followed cooking, and cleaning the kitchen cupboards was done either every day or once per week. These chores took 9 min on average, during which women used an all-purpose cleaner and bleach or a mixture of dishwashing detergents. Three participants (11%) soaked the kitchen sink twice per week using a toilet-bowl cleaner to prevent the buildup of scum.

All participants cleaned the bathroom every day for an average of 9 min. Seven women (25%) cleaned the bathroom more than once per day if visitors used it, or if they had large families. Even more, three women (11%) cleaned or disinfected the bathroom every time a household member used it.

Table 2

Participants' use of detergents by number of children in the household ( $n = 28$  women)

Number of children	Type of detergent used									
	Dishwashing detergent	Bleach	Liquid all-purpose cleaner	Powder all-purpose cleaner	Tub-tile cleaner	Toilet-bowl cleaner	Disinfectant	Glass cleaner	Laundry detergent	Laundry softener
	$N$ (%)	$N$ (%)	$N$ (%)	$N$ (%)	$N$ (%)	$N$ (%)	$N$ (%)	$N$ (%)	$N$ (%)	$N$ (%)
$\leq 1$	5 (28)	7 (26)	5 (25)	8 (38)	3 (27)	3 (14)	6 (30)	5 (26)	8 (29)	5 (28)
2+	13 (72)	20 (74)	15 (75)	13 (62)	8 (73)	18 (86)	14 (70)	14 (74)	20 (71)	13 (72)
Total <sup>a</sup>	18 (100)	27 (100)	20 (100)	21 (100)	11 (100)	21 (100)	20 (100)	19 (100)	28 (100)	18 (100)

<sup>a</sup>Calculated as the total number of women reporting the use of the corresponding type of detergent.

Table 3

Mean duration of cleaning activities involving exposure to chemicals and frequency of performance

Cleaning activity	Mean duration of activity in minutes $\pm$ standard deviation (Min–Max)	Frequency of performing the activity
Washing dishes	$7 \pm 5.0$ (2–26)	Daily (3–4/day)
Bathroom cleaning	$9 \pm 4.4$ (4–22)	Daily
Floor cleaning	$32 \pm 11.0$ (3–50)	Daily (>1/day)
Window cleaning	$35 \pm 30$ (3–120)	2/month
Manual washing of laundry	$15 \pm 67.5$ (15–120)	4/week

Consequently, all participants used all-purpose cleaners and dishwashing detergents on a daily basis and 26 women (93%) used bleach and six women (21%) also used disinfectants on a daily basis.

Seventy-nine percent of the women (22) cleaned the floor on a daily basis for an average of 30 min. Forty-six percent of the women (13) swept it more than once per day when they had visitors. This chore was performed more frequently during summer because there was more dust, there were no carpets on the floor, and also because sweeping was perceived to impart a cooling effect. All-purpose cleaner was mainly used and often with a bleach, or instead, a disinfectant was used alone to clean the floor.

Sixty-eight percent of the women (19) cleaned the windows twice per month for an average of 37 min. A glass cleaner was mostly used but also, less frequently, a dishwashing detergent or an all-purpose cleaner was used, sometimes with the addition of bleach.

Laundry was done on average four times per week. All participants used laundry detergent and 16 (57%) used a softener as well. Four participants (14%) added bleach for white laundry. Two-thirds of the participants had an automatic washing machine, where there was no hand contact with detergents. The others had a manual washing machine with an average hand contact duration of 15 min per wash; they noted that a manual washing machine cleans the white laundry better and uses smaller amounts of detergents. One woman had both types of washing machine but mostly used the automatic one unless the clothes were of different colors.

### 3.2.3. Detergent consumption

In general, women consumed large quantities of detergents.

...they say put one spoon of bleach to 15 liters of water but I empty the bottle.

...I add more detergents because I think it would be cleaner.

A couple of women noted that they buy detergents as frequently as they buy food.

I buy a bottle of bleach once every three days; my neighbor cannot believe it...it's driving her crazy...

Fifty-seven percent of women did not measure the quantity of detergent used.

I just pour, I do not control it...I pour according to what I think the right amount is.

Only 43% of the women measured the quantity of detergent they used.

...When I use a detergent I measure the amount in the cap.

One woman had to cut down on the amount of detergents due to economic reasons.

It used to be different... things have changed... now I use less...I cannot afford to buy detergents in large quantities anymore...it's all related to my husband's salary.

The average amount of detergent used per cleaning activity and the average number of detergent bottles consumed per month are described in Table 4. Between 2 and 5 mL of dishwashing detergent was used in each cleaning activity except washing laundry. Bleach was used in all five cleaning activities with different quantities varying between 13 and 23 mL. The all-purpose cleaner in its powder form was used more than in its liquid form. A disinfectant was used for dishwashing, bathroom cleaning, and floor cleaning only. On average, six sprays of glass cleaner were used for window cleaning. Around three cups of laundry detergents and one capful of laundry softener were used for washing the laundry.

On average, women consumed one to two bottles of liquid dishwashing detergents and/or one or two bags of all-purpose powder cleaner per month. Also, on average, women consumed one bottle of all-purpose liquid cleaner, one to three bottles of bleach, one bottle of toilet-bowl cleaner, two bottles of disinfectant, one-half bottle of tub and tile cleaner, one-third bottle of glass cleaner, one box or two bags of laundry detergent, and one bottle of laundry softener per month.

#### 3.2.4. Storage of detergents

I store them under the kitchen sink, it's the perfect place to store detergents.

Ninety-six percent of the participants stored detergents in the kitchen. They mainly stored them separately from other household items either to avoid contamination of food with odors or toxic agents, or for tidiness. On the other hand, 19% of the participants stored detergents with or near food (oil, water bottles, and beans) and revealed that they were unaware of any potential consequences. Fifty-six percent stored detergents under the kitchen sink either for easy reach, tidiness, or safety reasons; when placed under the kitchen sink, the detergents would be far from children's reach according to some women. Twenty-six percent of the women stored detergents on the kitchen bench top near the sink, for easy reach during dishwashing. In 19% of households, drinks (water bottles) or food (pasta) were placed on the bench top near the sink in close proximity to detergents.

None of the women placed detergents in open areas such as windowsills or tops of refrigerators, with the exception of one woman who stored a "strong" toilet-bowl detergent in the open window of an attic above the kitchen to keep it out of children's reach. Seventy percent of the participants stored detergents in their original containers and the others stored them in used containers (different from the original) without modifying the label. Only one woman said that she wrote the name of the detergent on the container to prevent accidents. Usually, laundry and powdered dishwashing detergents were stored in small plastic buckets different from their originals (mainly plastic bags) for easy handling. Bleach and laundry softener were mainly put in a shampoo bottle or a nozzle-top dishwashing detergent bottle. Some

detergents, mostly disinfectants, were stored in small, transparent water bottles. One reason for changing the container was to divide a large volume of detergent into smaller, more convenient containers, such as plastic buckets or tanks, on water and soft drink bottles. Another reason was to control the quantity of detergent poured or to avoid hand contact if the detergent was put into smaller or nozzle-top bottles, for example, dishwashing detergents and shampoos.

#### 3.2.5. Cleaning methods

Women employed various methods in performing cleaning chores. Twenty-two women (79%) soaked the area to be cleaned with detergent for some time in order to increase the cleaning effect, decrease time of contact with the detergent, or "save time" in cleaning. In general, the toilet-bowl cleaner was left to soak for 5–20 min.

Four women (14%) used hot water to avoid personal contact with cold water in the winter, to remove grease, or to save time in cleaning. It was also common to put dirty cookware on the fire to boil water with detergent as a method of cleaning. A common strategy (not used with glass cleaners) was to dilute the detergent in water before use.

The water–detergent mixture was changed more than once when the cleaning mixture became dirty. Hence the detergent was added more than once during a cleaning activity; additional amounts of detergents were generally used in the "grand ménage" (spring cleaning).

Five women (18%) used only water with no detergent to remove dust and to clean glass. A detergent with a pleasant smell is sometimes added to the final rinsing water bucket to impart a pleasant odor to the house.

#### 3.2.6. Mixing detergents

A mixture of detergent removes stains quickly.

Women mixed different types of detergents. Ninety-three percent of women mixed bleach with other detergents, especially dishwashing detergent and powdered all-purpose cleaner. Women also mixed bleach with toilet-bowl cleaner (four women), and laundry detergent (five women). The interviews revealed many reasons for adding bleach to other household detergents. In general, women added bleach to get rid of unpleasant smells and remove the greasy material that comes from certain food such as eggs and meat, and sometimes from people's breath. Women noted that bleach removes stains quickly, whitens clothes, cleans and shines better than detergent alone, leaves a pleasant smell, and kills microbes and insects.

Women who did not mix detergents or avoided mixing certain types of detergents were concerned with possible harmful effects of mixing, either because of a bad personal experience or because they had been warned by someone else.





### 3.2.7. *Alternative methods*

Twenty-one percent of the participants replaced household detergents with alternative substances. These included kerosene fuel for cleaning floors and toilet bowls as an alternative to bleach or disinfectant; oil soap for cleaning ovens, pots, and floors, vinegar for cleaning and shining stainless-steel sinks; lemon pieces or lemon juice to wash dishes and ovens in order to remove grease and impart a pleasant smell; and fermented yogurt (acidic) for cleaning sinks.

Several women had modified their detergent consumption. Four women limited their use or purchased cheaper detergents as they could no longer afford them. Five women used less detergent since they were concerned about its possible effects on their children.

Before I had children, I used more quantities because the odor did not matter much. But once I had children, I reduced the quantities because the odors harm children.

On the other hand, three women (11%) increased the amount of detergent used after having children because they felt “more is better” or because they had children whose presence required more cleaning.

### 3.2.8. *Psychosocial factors*

#### 3.2.8.1. *Family*

My husband is obsessed with cleanliness ... he makes me clean more...I have a large family... I cannot keep up with my family's demands. (39-year-old women)  
...if my husband comes (home), he does not like to find dirty dishes in the sink, or dirty clothes on the rack ...I prefer to put everything in its place before he comes home. So, sometimes I work twice per day.

Cleaning was imposed on some women by the family or the husband. Two women said that their husbands demanded extreme levels of cleanliness. This made them clean more than once per day.

Six women (21%) mentioned that large families resulted in more cleaning activities such as dishwashing, bathroom cleaning, and laundry washing, as they had big families.

I do the laundry every day, sometimes twice or even three times a day, because I have a large family.

The presence of children in the house made women clean more, as they wanted their children to live in a clean environment free of disease. Thirty-six percent of the participants said that they used more detergents now that they had children and 18% said that they cleaned the bathroom more than once a day because they had boys or young children. Women swept the floor more frequently (twice or three times a day) in the presence of young children who soil the floor and walk barefoot or crawl. A woman swept and disinfected after her children with bleach and an all-purpose cleaner. Women said that they cleaned windows more frequently because their children soiled

them with their hands. Children, babies, or boys induced more laundry and hence frequent use of detergents.

3.2.8.2. *Personal preference.* Cleanliness was more important than food for one woman and for another, it was more important than taking care of herself.

Cleanliness to me is more important than food and drink.

...for sure the most important thing is cleanliness. I spend all my money on cleanliness, on the house...I mean I prefer to buy things for the house and take care of the house before I take care of myself.

For half the women (14), cleaning stimulated a feeling of comfort.

...when the house is clean I feel clean from the inside and comfortable, and if the house is dirty, I feel pessimistic....

I am psychologically relaxed when my house is clean. If the house is crowded and dirty, I become confused and uncomfortable ....

#### 3.2.8.3. *Fear of gossip*

If some woman came and saw my house unclean she would go and tell.

Women were very conscious of other women's comments on their cleanliness/lack of cleanliness in their house. It was an issue of reputation.

...If I get visitors, I would not like them to say: “...I went to her house, she is dirty!” ... “this woman is dirty, she leaves her house and goes out.” ... I do not like to be criticized.

3.2.8.4. *Sharing domestic chores.* Fifty percent of women received occasional or minimal help from household members with domestic chores. Daughters gave assistance in washing the dishes, sweeping floors, and cleaning the dust only in the summer when school was closed. Husbands provided occasional help when the wife was sick or pregnant.

### 3.2.9. *Protective measures*

Protective measures adopted by women in the use of detergents included mainly wearing gloves, taking a final rinse with clean water, ventilating, and reducing their proximity to detergents. Only one woman always wore gloves while washing dishes and cleaning the bathroom, floor, and windows. During the observations only two women wore gloves while washing the dishes and cleaning the bathroom. In the interviews, women noted that they wear gloves only in winter to avoid allergies caused by hot water and detergents (two women) or when they used the toilet-bowl cleaner or bleach, as they were “strong” detergents (three women). The interference of gloves in the cleaning process was the main justification for not

wearing them: dishes would not be properly cleaned; also, dishes would slip from their hands. Two women stated that they would not wear gloves for as long as they have not developed an allergy. For one participant, wearing gloves in summer induced a skin allergy. Women took a final rinse of the cleaned area with only water without adding any detergents. Most of the participants rinsed well after cleaning the kitchen (86%) and bathroom (79%), and more than half of the participants (57%) rinsed well after cleaning the floor. Only one participant washed her hands as a protective measure after cleaning the dishes, bathroom, floor, and windows and doing the laundry. Seventy-one percent of the participants washed their hands after washing dishes, 54% said they washed their hands after cleaning the bathroom, and 61% said they washed their hands after sweeping the floor.

I keep the windows closed while cleaning...Once my neighbor could not get in because of the strong smell of bleach as I was sweeping the floor! (24-year-old woman).

However, the majority (93%) said that they opened windows for general ventilation, or because the weather was hot, rather than to reduce exposure to detergents. Most of the participants (89%) opened windows while cleaning to ventilate. Two women said that they opened the windows in order to reduce exposure to detergents. During the observations, 46% of the participants cleaned under poorly ventilated conditions, especially in the bathroom, where sometimes the emanations from the detergents were so strong that they burned the researcher's eyes.

She [wife] cleans a lot and she uses a lot of detergents, especially bleach. When she [wife] is washing the dishes, she is so close and right above the sink... fumes get to her face! [a woman's husband].

The observation sessions indicated that the women frequently bring their faces close to detergents by bending toward the areas they are cleaning. Table 5 shows the bending degrees in different cleaning activities. Around 29% of the participants bent at a 60° angle toward the sink while dishwashing. In the bathroom, 39% of the participants bent at a 60° angle over the sink and almost all of them bent 45° over the toilet bowl while cleaning it. To clean hard-to-reach areas, 27 women (96%) bent 45° toward the floor; 11 (39%) cleaned on their knees using a mop with no handle. Forty-three percent of the women cleaned barefoot and explained that it is more comfortable and quicker to clean. Thirty-six percent had their legs in contact with detergents due to cleaning the bathroom barefoot. Furthermore, 33% had their legs in contact with detergents as they swept the floor barefoot.

#### 4. Discussion

This study explored women's strategies for handling household detergents and added to the understanding of their potential exposure to chemical detergents. The use of

Table 5  
Bending when cleaning

Degree of bending (°)	N (%) <sup>a</sup>
Over the kitchen sink	
90	23 (82.1)
60	8 (28.6)
45	3 (10.7)
Over the bathroom sink	
90	9 (32.1)
60	11 (39.3)
45	10 (35.7)
30	1 (3.6)
Over the toilet bowl	
60	1 (3.6)
45	27 (96.4)
Over the floor	
60	1 (3.6)
45	27 (96.4)
30	11 (39.3)

<sup>a</sup>During the observations, some women bent at different angles while cleaning, and were counted in more than one category; therefore percentages do not add to 100% as categories overlap.

an ergonomics methodology provided access to important information concerning how women make choices that affect their environmental exposures. Women in Nabaa did a lot of cleaning activities and used cheap/affordable detergent imitations sold in the Lebanese market, which were less effective, inducing the women to use larger quantities.

Our results indicated that the majority of women in the studied sample did not take notice of the potential hazards of storing household detergents under or on top of the sink, in close proximity to food and shampoo, and in nonoriginal containers without proper labels. Women's main concern was to maintain a clean and safe home for their families and children. Few women used precautions such as storing detergents separately, always in their original containers, in closed areas, on high shelves, and away from children's reach. Christenbury (1996) emphasized the importance of the proper storage of household detergents with a proper label and away from children's reach and Barron et al. (1999) further recommended that different types of detergents be placed in separate cupboards and not on shelves next to or over each other, as some are chemically reactive; for instance, detergents such as glass cleaners with ammonia should not be stored with tub and tile cleaners containing bleach. The feasibility of this recommendation is questionable in light of women's space constraints. In our study, women's storage practices largely depended on the availability of space in their relatively small apartments. Greater accessibility and easy reach also mattered to most women who performed cleaning activities (washing dishes, bathrooms and floors) on at least a daily basis.



Generally, women reported consuming large quantities of detergents, a monthly average of 1 or 2 bottles of each of the various types of detergents they used. Our observations showed that the quantities of detergents used by women exceeded the manufacturers' recommendations. For instance, on average, women used five drops of dishwashing detergent per wash, while the recommended amount for use was 2 drops according to the label of a popular brand. The interviews confirmed this over-consumption; some women stated that they would purchase even more should detergent products become more affordable.

The high level of consumption and the frequency and the duration of cleaning activities, in addition to certain strategies employed by the women, increased their chemical exposure. In an attempt to get better cleaning results, women changed the water–detergent mixture several times, added a detergent with a pleasant odor in the final rinse, washed clothes manually, and used hot water in the cleaning activities. Volatile chemicals found in household detergents evaporate because of hot water and become available in larger amounts in the surrounding environment (Christenbury, 1996).

Cleaning strategies such as avoiding the use of hot water, diluting each detergent as much as possible, and applying soft nonacidic or nonabrasive detergents for a few minutes have been recommended to reduce exposure to detergents (Barron et al., 1999). The majority of women mixed different types of detergents or detergents with bleach, and some mixed bleach with toilet-bowl cleaners. Mixing bleach containing sodium hypochlorite with toilet-bowl cleaner containing hydrochloric acid or a detergent containing ammonia has been shown to result in adverse health effects (Mapp et al., 2000). Gases resulting from these mixtures can cause lung irritation, sore throat, headaches, and breathing difficulty (Gapany-Gapanavicius et al., 1982; Mapp et al., 2000).

In general, women used nine different types of detergents, thus leading to diverse chemical exposure and increasing the risk of mixing incompatible chemicals. The use of an all-purpose cleaner has been recommended, to limit exposure to multiple chemical products (Christenbury, 1996).

Most of the women opened the windows while cleaning for ventilation. However, this was not possible in the bathroom, where the ventilation was generally poor. Many also rinsed well after cleaning, and consequently reduced exposure to detergents. However, some women did not wash their hands after cleaning and stood in close proximity to the area being cleaned. Many did not wear gloves, cleaned barefoot, and did not follow the label warnings or directions for use. Although protective measures have been recommended during the use of chemical detergents (Barron et al., 1999), low compliance with reading the products' labels and wearing gloves while cleaning has been previously reported among consumers (Kovacs et al., 1997; Weegels and van Veen, 2001).

Previous research documented that people's perceptions of chemical products affected the way they handled them and consequently affected their exposure (Cordeiro, 2002; Weegels and Kanis, 2000). Could a product that helps clean and remove dirt and provides a hygienically safer milieu possibly do any harm? Several women reported a lack of awareness of the hazards involved in over-exposure to chemical detergents. Some were also indifferent to these hazards; their maternal instinct and their priority to protect their children from dirt came first [*"I cannot rest... I do a lot of cleaning because I have children"* (28-year-old mother)]. In general, women said that children, and specifically boys, "dirty more" and bring on more work, which made them use more quantities of household detergents.

In our sample, women with large families did more work, as was reported by Ghysels (2000); however, assistance and sharing in the cleaning activities did not increase.

Maintaining a clean house appeared to be one of the women's prime obligations. Janet Wondra wrote: "There are specific rules for cleaning ... normally these rules are handed down on the distaff side, as we used to say, from grandmother to mother to daughter, from time immemorial and onward into eternity" (Wondra, 2005, p. 529).

Women tried to avoid any criticism from family members or friends on their cleaning habits. A reputation of being a "clean woman" was of great importance; cleanliness was much favored in society and was associated with virtuous traits. Women felt guilty if their "household responsibilities" were not accomplished; they felt great social pressure (Noor, 2002). The deeply embedded cultural importance of cleanliness was obvious in women's remarks, expressions, and body language during the in-depth interviews.

Women worked hard to keep their houses clean and to "deserve appreciation" and "approval," although their work was mostly unshared and unnoticed. The "invisibility of the cleaning function" and "the assumption that women's work in cleaning is particularly easy" has been pointed out by Messing (1998b).

Cleaning chores performed by homemakers in Nabaa, including washing, sweeping, mopping, and others, largely resembled those performed by paid workers in cleaning services. While some of these occupational populations have been identified to have elevated exposures to chemical detergents (Messing, 1998a), homemakers' exposure to such agents in the home environment has been largely ignored. It should be noted that chemical exposures in the general population have been insufficiently understood, and measuring multiple chemical exposures and establishing dose–response relationships, in both workers and the general population, has been challenging to scientists (Rosenburg, 1997).

The similarities between homemakers in Nabaa and paid cleaners include constraints and requirements that are common to the home environment and the workplace. For

instance, the needs to clean quickly and efficiently, mix detergents, and use larger quantities to achieve better results (Messing, 1998a) are common features; the source of pressure may be a difficult household member (e.g., husband/in-laws) in the home environment and a supervisor in the workplace. In addition, both homemakers and paid cleaners may have limited knowledge of the safety practices required in handling chemical detergents.

On the other hand, differences between the home environment and the workplace include constraints related to storage, choice of product, and length of workday among others. For example, in Nabaa, the built environment is characterized by cramped spaces, which affected women's housework practices and strategies for handling and storing chemical detergents. In contrast, paid cleaners are in general more likely to have a larger storage space. Also, while homemakers in Nabaa had relatively more freedom in choosing the cleaning agent, paid cleaners often use what's available in the workplace. Finally, while paid workers in the cleaning service go home after a workday, homemakers in Nabaa live in the workplace.

#### 4.1. Study limitations

Although this study provided useful information, it had some limitations. Daily life scenarios may not have been fully captured, since each participant was observed once where some cleaning strategies might have been overlooked. Further observations are needed to capture more complete exposure scenarios and recommend future interventions with women's participation and contribution.

#### 5. Conclusion

Using a previously established ergonomic approach (Guérin et al., 1997; Messing et al., 2005), this study presented the findings of in-depth interviews and observations of women performing domestic cleaning activities. Women's strategies for handling household detergents depended on several constraints and requirements, many of which were measured and presented in this paper.

Building on the observed use of potentially toxic chemical detergents by homemakers, we propose to take such long-term exposures as a serious public health concern.

#### Acknowledgments

The authors are grateful to all the women in Beirut who participated in this study. The authors thank Karen Messing for providing guidance in the first phase of this project.

This study was funded by a grant to Rimo R. Habib from the University Research Board at the American University of Beirut.

#### References

- Arif, A.A., Whitehead, L.W., Delclos, G.L., Tortolero, S.R., Lee, E.S., 2002. Prevalence and risk factors of work-related asthma by industry among United States workers: data from the third national health and nutrition examination survey (1988–94). *J. Occup. Environ. Med.* 59, 505–511.
- Arif, A.A., Delclos, G.L., Whitehead, L.W., Tortolero, S.R., Lee, E.S., 2003. Occupational exposures associated with work-related asthma and work-related wheezing among US workers. *Am. J. Ind. Med.* 44 (4), 368–376.
- Atkinson, R., Flint, J., 2001. Accessing hidden and hard-to-reach populations: snowball research strategies. *Social Research Update* 33 [On-line]. Retrieved: <http://www.soc.surrey.ac.uk/sru/SRU33.html>
- Barron, T., Berg, C., Bookman, L., 1999. How to Select and Use Safe Janitorial Chemicals? Project Completion Report, Pollution Prevention Incentives for States, US EPA Region IX, California EPA [On-line]. Available from: <http://www.wrppn.org/Janitorial/05%20Report.pdf> (accessed April 2004)
- Centers for Disease Control and Prevention (CDC), 2000. Divisions of HIV/AIDS Prevention. CDC EZ—TEXT [On-line]. Retrieved: <http://www.cdc.gov/hiv/software/ez-text.htm>
- Cherry, N., Meyer, J.D., Adisesh, A., Brooke, R., Owen-Smith, V., Swales, C., Beck, M.H., 2000. Surveillance of occupational skin disease: EPIDERM and OPRA. *Br. J. Dermatol.* 142 (6), 1128–1134.
- Christenbury, J.H., 1996. Reducing hazardous products in the home [online]. Available from: <http://www.cdc.gov/nasd/docs/d001201-d001300/d001243/d001243.pdf> (accessed April 2004).
- Cordeiro, R., 2002. Suggestion of an inverse relationship between perception of occupational risks and work-related injuries. *Cad. Saúde Pública*, Rio de Janeiro 18 (1), 45–54.
- Demo, D.H., Acocck, A.C., 1993. Family diversity and the division of domestic labor. How much have things really changed? *Fam. Relat.* 42, 323–331.
- Dickel, H., Kuss, O., Schmidt, A., Kretz, J., Diepgen, T.L., 2002. Importance of irritant contact dermatitis in occupational skin disease. *Am. J. Clin. Dermatol.* 3 (4), 283–289.
- European Centre for Ecotoxicology and Toxicology of Chemicals (ECETOC), 1994. Assessment of non-occupational exposure to chemicals. Technical Report No. 58. Brussels, Belgium.
- Fowler, J.F., 1998. Occupational dermatology. *Curr. Probl. Dermatol.* 10 (6), 211.
- Games International Incorporated, 2004. SPSS Version 12.0, CD-ROM.
- Gapany-Gapanavicius, M., Yellin, A., Almog, S., Tirosh, M., 1982. Pneumomediastinum: a complication of chlorine exposure from mixing household cleaning agents. *J. Am. Med. Assoc.* 248 (3), 349–350.
- Ghysels, J., 2000. Influence of family type on work in Denmark, Belgium and Spain. In: Harvey, C.D.H. (Ed.), *Walking a Tightrope: Meeting the Challenges of Work and Family*. Ashgate, pp. 43–67.
- Guérin, F., Laville, A., Daniellou, F., Duraffourg, J., Kerguelen, A., 1997. *Comprendre Le Travail Pour Le Transformer*, second ed. ANACT, Montrouge, France.
- Habib, R.R., Nuwayhid, I., Merhi, M., Myntti, C., 2005. Gendered division of household responsibilities in the urban outskirts of Beirut. In: *Proceedings of the IV International Congress on Women Work & Health*, New Delhi, 27–30 November, p. 74.
- Hakkinen, P.J., 1993. Cleaning and laundry products, human exposure assessments. In: *Handbook of Hazardous Materials*. Academic Press, San Diego.
- Hughson, G.W., Aitken, R.J., 2004. Determination of dermal exposures during mixing, spraying and wiping activities. *Ann. Occup. Hyg.* 48 (3), 245–255.
- Ivanov, T., Uzunova, S., Bainova, A., Yantcheva, M., 1997. Study on the adverse health effects from the application of modern household chemical products in Bulgaria. *Khig. Zdraveopaz.* 40 (3–4), 60–62.

- Karjalainen, A., Martikainen, R., Karjalainen, J., Klaukka, T., Kurppa, K., 2002. Excess incidence of asthma among Finnish cleaners employed in different industries. *Eur. Respir. J.* 19 (1), 90–95.
- Kogevinas, M., Anto, J.M., Sunyer, J., Tobias, A., Kromhout, H., Burney, P., 1999. Occupational asthma in Europe and other industrialized areas: a population-based study. *Lancet* 353, 1750–1754.
- Kovacs, D.C., Small, M.J., Davidson, C.I., Fischhoff, B., 1997. Behavioral factors affecting exposure potential for household cleaning products. *J. Exp. Anal. Environ. Epidemiol.* 7 (4), 505–520.
- Makhoul, J., 2003. Physical and social contexts of the three urban communities of Nabaa, Borj el Barajneh Palestinian camp, and Hay el Sellom. Unpublished manuscript, Center for Research on Population and Health, American University of Beirut.
- Mapp, C.E., Pozzato, V., Pavoni, V., Gritti, G., 2000. Severe asthma and ARDS triggered by acute short-term exposure to commonly used cleaning detergents. *Eur. Respir. J.* 16 (3), 570–572.
- Medina-Ramon, M., Zock, J.P., Kogevinas, M., Sunyer, J., Anto, J.M., 2003. Asthma symptoms in women employed in domestic cleaning: a community based study. *Thorax* 58, 950–954.
- Mergler, D., 1999. Combining quantitative and qualitative approaches in occupational health for a better understanding of the impact of work-related disorders. *Scand. J. Work Environ. Health* 25, 54–60.
- Messing, K., 1998a. Indoor Cleaning Services, vol. III. International Labor Organization Encyclopedia of Occupational Health and Safety, ILO, Geneva, Switzerland.
- Messing, K., 1998b. Hospital trash: cleaners speak of their role in disease prevention. *Med. Anthropol. Q.* 12 (2), 168–187.
- Messing, K., Seifert, M.A., Vezina, N., Balka, E., Chatigny, C., 2005. Qualitative research using numbers: an approach developed in France and used to transform work in North America. *New Solutions* 15 (3), 245–260.
- Mohammed-Brahim, B., 1999. Ergotoxicology: towards an operational prevention of chemical risk in the working environment. *International Encyclopedia of Ergonomics and Human Factors*, second ed. University of Louisville, Louisville, Kentucky, USA.
- National Library of Medicine. 2003. Household Product Database. Accessed online from: <http://householdproducts.nlm.nih.gov>
- Noor, N., 2002. Work-family conflict, locus of control, and women's well-being: tests of alternative pathways. *J. Soc. Psychol.* 142 (5), 645–662.
- Rosenburg, J., 1997. Clinical toxicology. In: LaDou, J. (Ed.), *Occupational and Environmental Medicine*, second ed. Appleton and Lange, pp. 171–179 (Chapter 13).
- Rosenman, K.D., Reilly, M.J., Schill, D.P., Valiante, D., Flattery, J., Harrison, R., Reinisch, F., Pechter, E., Davis, L., Tumpowsky, C.M., Filios, M., 2003. Cleaning products and work-related asthma. *J. Occup. Environ. Med.* 45 (5), 556–563.
- Teiger, C., Bernier, C., 1992. Ergonomic analysis of work activity of data entry clerks in the computerized service sector can reveal unrecognized skills. *Women Health* 18, 67–78.
- van Veen, M.P., Van Engelen, J.G., van Raaij, M.T.M., 2001. Crossing the river stone by stone: approaches for residential risk assessment for consumers. *Ann. Occup. Hyg.* 45 (1001), 107–118.
- Weegels, M.F., Kanis, H., 2000. Risk perception in consumer product use. *Accid. Anal. Prevent.* 32 (3), 365–370.
- Weegels, M.E., van Veen, M.P., 2001. Variation of consumer contact with household products: a preliminary investigation. *Risk Anal.* 21 (3), 499–511.
- Wondra, J., 2005. Cleaning theory. *Southern Rev.* 41 (3), 529–534.
- Zock, J.P., Kogevinas, M., Sunyer, J., Jarvis, D., Toren, K., Anto, J.M., 2002. Asthma characteristics in cleaning workers, workers in other risk jobs and office workers. *Eur. Respir. J.* 20 (3), 679–685.